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CHEMICAL ABSTRACTS, vol. 104, no. 19, 12th May 1986, page 43, abstract no.161810v, Columbus, Ohio, US; M. HIBERT et al.: "Stereoselective blockade at the5-HT autoreceptor and inhibition of radioligand binding to central 5-HTrecognition sites by the optical isomers of methiothepin", &NEUROPHARMACOLOGY 1986, 25(1), 1-4

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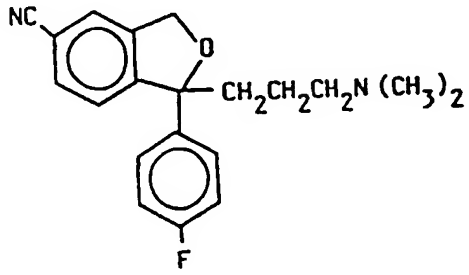
Description

The present invention relates to the two novel enantiomers of the antidepressant drug 1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile (citalopram) of the following formula I:



I

and to the use of these enantiomers as antidepressant compounds as well as the possible use as geriatrics or in the cure of obesity or alcoholism.

This invention also includes pharmaceutically-acceptable salts of the enantiomers of compound I formed with non-toxic organic or inorganic acids. Such salts are easily prepared by methods known to the art. The base is reacted with either the calculated amount of organic or inorganic acid in an aqueous miscible solvent, such as acetone or ethanol, with isolation of the salt by concentration and cooling or an excess of the acid in aqueous immiscible solvent, such as ethyl ether, ethyl acetate or dichloromethane, with the desired salt separating directly. Exemplary of such organic salts are those with maleic, fumaric, benzoic, ascorbic, pamoic, succinic, oxalic, salicylic, methanesulfonic, ethanedisulfonic, acetic, propionic, tartaric, citric, gluconic, lactic, malic, mandelic, cinnamic, citraconic, aspartic, stearic, palmitic, itaconic, glycolic, p-amino-benzoic, glutamic, benzene sulfonic and theophylline acetic acid, as well as the 8-halotheophyllines, for example 8-bromotheophylline.

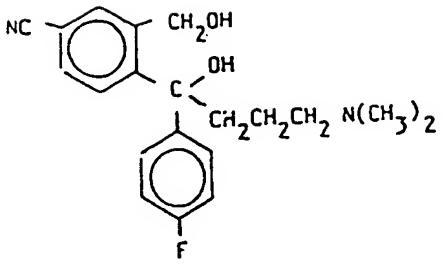
Exemplary of such inorganic salts are those with hydrochloric, hydrobromic, sulfuric, sulfamic, phosphoric and nitric acids. Of course, these salts may also be prepared by the conventional method of double decomposition of appropriate salts, which is well-known to the art.

Furthermore it was found that non-hygroscopic acid addition salts might be obtained by conventional freeze drying techniques from water solutions of appropriate salts of the above mentioned kinds.

The invention is also concerned with a method to resolve the racemate of I into the individual isomers.

Citalopram, which has been disclosed in eg. US Patent No. 4,136,193, has proven to be an efficient antidepressant compound in man (Ref.: A. Gravem et al., Acta psychiat. Scand., No. 75, p. 478-486 (1987). All work in the development of this compound has been made with the racemate. Citalopram has been shown pharmacologically to be a very selective inhibitor of 5-HT reuptake. Previous attempts to crystallize diastereomeric salts of citalopram enantiomers have failed.

Surprisingly, it has now proven possible to resolve the intermediate 4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile, II, into its enantiomers and finally in a stereoselective way to convert these enantiomers to the corresponding citalopram enantiomers. Likewise, monoesters of II formed by optically active carboxylic acids could be separated into the corresponding diastereomers and subsequently converted directly into citalopram enantiomers in a stereoselective ring-closure reaction. The intermediate diol, II, has been disclosed in eg. US Patent No. 4,650,884 as a racemic mixture.



II

The enantiomers of the intermediate of formula II as well as monoesters fall likewise within the scope of the present invention.

Furthermore, it was shown to our surprise that almost the entire 5-HT uptake inhibition resided in the (+)-citalopram enantiomer.

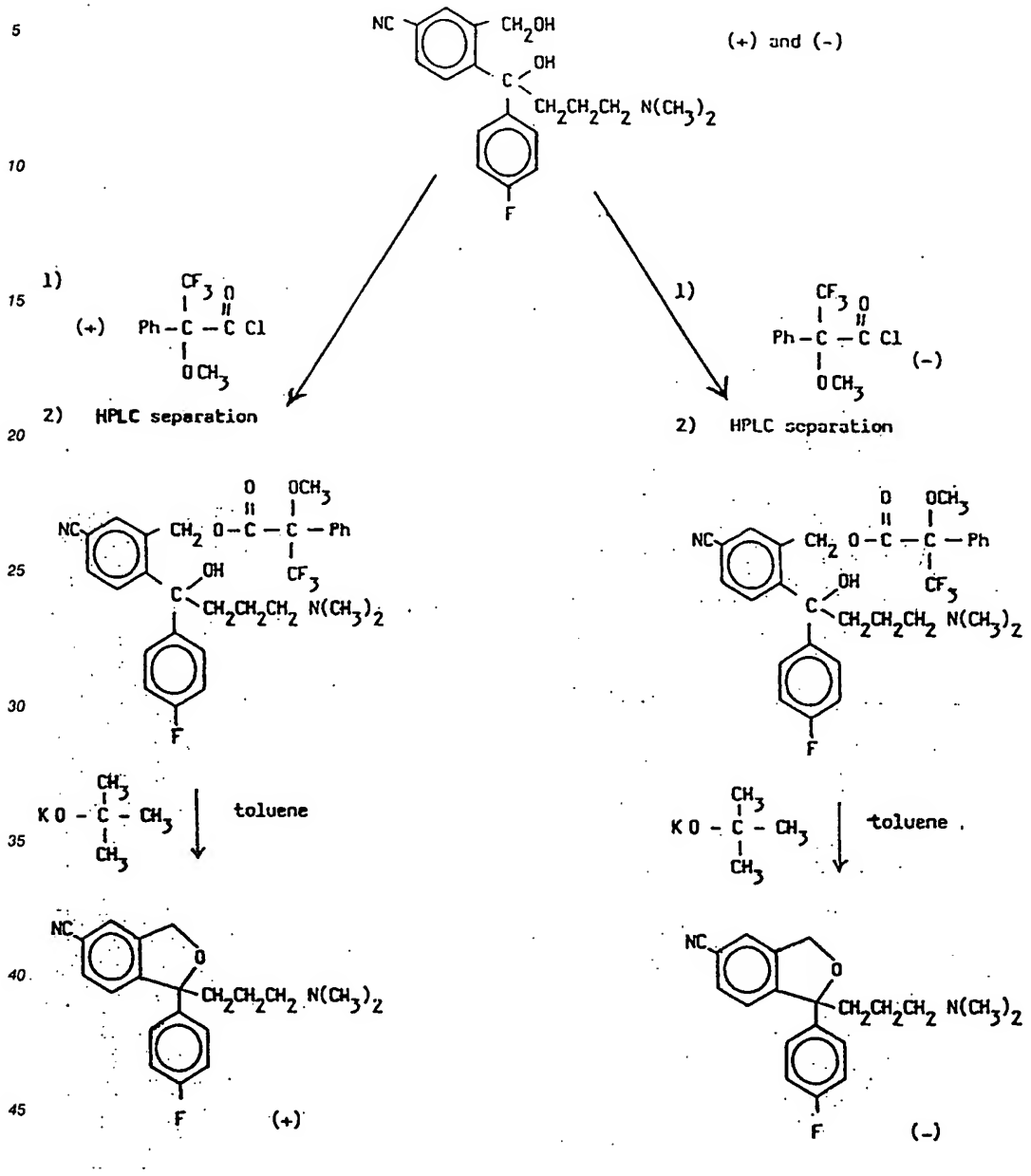
The present invention also includes a new method of synthesizing I from the diol compound II by esterification of the primary alcohol group into a labile ester, which in the presence of a base undergoes spontaneous ringclosure to citalopram or, if enantiomerically pure II is esterified, the corresponding citalopram enantiomer is produced with fully conservation of stereoconfiguration.

According to the invention, II is reacted with:

a)

an enantiomerically pure acid derivative as an acid chloride, anhydride or labile ester as eg. exemplified in reaction scheme I by (+)- or (-)-α-methoxy-α-trifluoromethylphenylacetyl chloride. The reaction is preferably performed in an inert organic solvent as eg. toluene, dichloromethane or tetrahydrofuran. A base (triethylamine, N,N-dimethylaniline, pyridine or the like) is added to neutralize liberated HCl. The diastereoisomers are subsquently separated by HPLC or fractional crystallization. The thus-purified diastereoisomers are finally separately treated with strong base (eg. alkoxide) in an inert organic solvent as eg. toluene, tetrahydrofuran, or dimethoxyethane yielding the pure citalopram enantiomers respectively. The ringclosure reaction is preferably performed at relatively low temperatures (-20 °C to room temperature).

REACTION SCHEME I



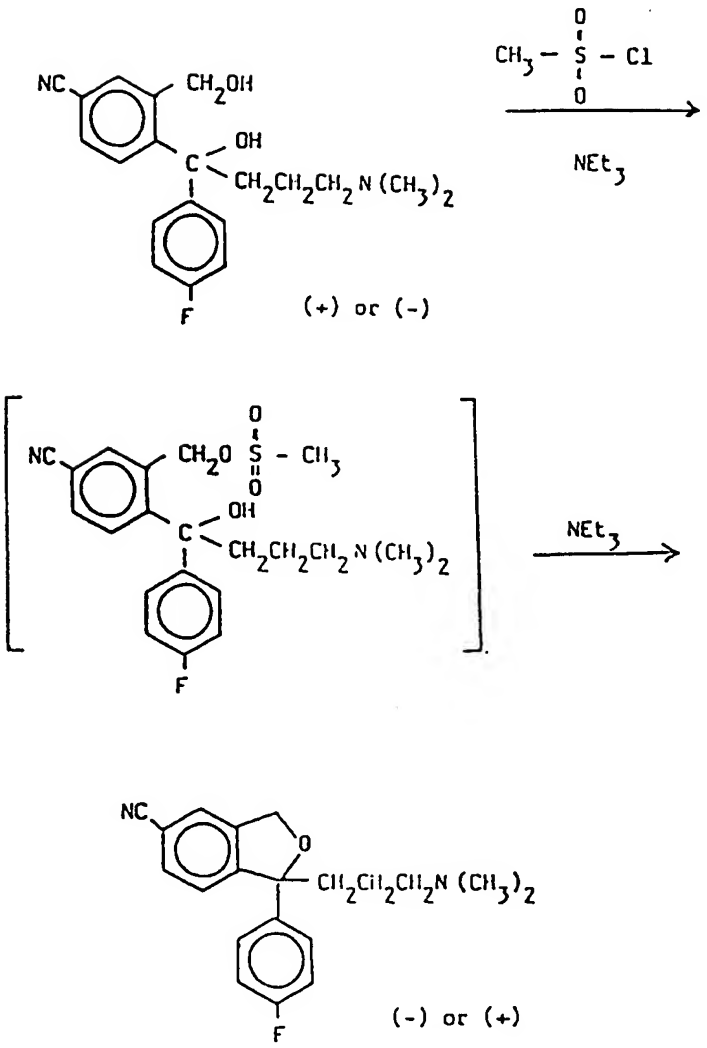
b)

the enantiomers of an optically-active acid successively affording the pure diastereomeric salts. Optically antipodes of tartaric acid, di-benzoyltartaric acid, di-(p-toluoyl)tartaric acid, bisnaphthylphosphoric acid, 10-camphorsulphonic acid and the like are conveniently used.

c)

Stereoselective ringclosure of the pure enantiomers of II prepared as in b) is performed via a labile ester as eg. methansulfonyl, p-toluenesulfonyl, 10-camphorsulfonyl, trifluoroacetyl or trifluoromethansulfonyl with simultaneous addition of a base (triethylamine, dimethylaniline or pyridine) in an inert organic solvent at 0 °C. The ringclosure reaction is exemplified in reaction scheme II:

REACTION SCHEME II



EXAMPLE 1

Resolution by method a)

To 11g of (+)-α-methoxy-α-trifluoromethylacetic acid dissolved in 25 ml of chloroform were added 50 ml of thionylchloride and a few drops of dimethylformamide. The reaction mixture was refluxed for 2 hours. Excess of thionylchloride was evaporated with toluene leaving the (+)-α-methoxy-α-trifluoromethylacetyl chloride as a liquid. This liquid diluted with 50 ml of dichloromethane was added dropwise to an ice cooled solution of 17g of 4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile, II, and 8 ml of triethylamine in 150 ml of dichloromethane. The reaction mixture was further stirred for another hour at room temperature, subsequently washed with brine, dried ($MgSO_4$) and the solvent evaporated below 30 °C in vacuo affording 20g of the ester as a diastereomeric mixture. By repeated HPLC purification (eluted with ethyl acetate / tetrahydrofuran 9:1 containing 4% of triethylamine) and by collecting only the 5-10% initial substance in the main peak, 1.1g of enantiomerically pure compound was isolated.

The substance thus isolated was dissolved in dry toluene (50 ml) and added to a suspension of 0.3g of potassium t-butoxide in 20 ml of toluene at 0 °C. The toluene solution was washed with water, dried

($MgSO_4$) and the solvent evaporated yielding 0.6g of (+)-1-(dimethylaminopropyl)-1-(4'fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile as an oil. $[\alpha]_D$ = +11,81° (c = 1, CH_3OH) (determined with a substance containing 10% w/w of methanol). The optical purity was determined by ^1H NMR spectroscopy ($CDCL_3$ as solvent) (Bruker AC-250 MHz instrument) by addition of a 10:1 w/w surplus of the chiral reagent (-)-2,2,2-trifluoro-1-(9-anthryl)ethanol. Optical purity: 99.6%.

In a totally analogous way the (-)-1-(3-dimethylaminopropyl)-1 -(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile was synthesized. $[\alpha]_D$ = -12.34° (c = 1, CH_3OH) (determined with a substance containing 10% w/w of methanol). Optical purity: 99.9%.

EXAMPLE 2

Resolution by methods b) and c)

To a solution of 85g of 4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)-benzonitrile, hydrobomide in 500 ml of water were added 200 ml of ice-cooled 2 M NaOH solution and 500 ml of ether. The mixture was stirred for ½ hour, the ether phase separated, dried ($MgSO_4$) and the ether evaporated. The remaining oil was dissolved in 400 ml of 2-propanol at 40°C, and 40g of (+)-di-p-toluoyltartaric acid (as hydrate) were added under vigorous stirring. After a short while crystallization began. After 3 hours of stirring the precipitated salt was filtered off and dried yielding 29.2g (55.1%) of (-)-4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile,hemi (+)-di-p-toluoyl-tartaric acid salt. MP: 134-135°C, $[\alpha]_D$ = +10.0° (c = 1, CH_3OH). The filtrate is used below.

To an ice cooled solution of 14g of the (-)-isomer from above as a base in 300 ml of dry toluene were added 16 ml of triethylamine, and 3.6 ml of methansulfonyl chloride in 20 ml of dry toluene were added dropwise during 10 minutes. The reaction mixture was further stirred for ½ hour, washed with brine, dried ($MgSO_4$) and the solvent evaporated. The title compound was purified by column chromatography affording 8g of (+)-1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile. $[\alpha]_D$ = +12.33° (c = 1, CH_3OH).

The oxalic acid salt of the (+)-isomer crystallized from acetone. MP: 147-148°C, $[\alpha]_D$ = +12.31° (c = 1, CH_3OH).

The pamoic acid salt of the (+)-isomer was prepared in the following manner: To 1.8g of the base of the (+)-isomer was added 2g of pamoic acid in 25 ml of MeOH. The mixture was refluxed for an hour and subsequently cooled to room temperature. The precipitate was filtered off yielding 3.0g of the pamoic acid salt. MP: 264-266°C, $[\alpha]_D$ = +13.88°C (c = 1, dimethylformamide).

A 2:1 addition compound of the (+)-isomer with L(+)-tartaric acid was prepared in the following manner: 4g of the (+)-isomer as base were dissolved in 100 ml of diethyl ether and extracted into 100 ml of water containing 0.8g of L(+)-tartaric acid by stirring. The organic phase was separated and discarded. The waterphase was freeze-dried in vacuo (0.1 mm Hg) for 18 hours leaving 3.8g of a white powder of the title compound. This addition compound was stable and not hygroscopic.

In a corresponding manner as above via the (+)-4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile, hemi (-)-di(p-toluoyl)tartaric acid salt ($[\alpha]_D$ = -8.9° (c = 1, CH_3OH) which was converted to the corresponding diol base ($[\alpha]_D$ = +61.1° (c = 1, CH_3OH) and finally ringclosure reaction yielded 10g of (-)-1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile. $[\alpha]_D$ = -12.1° (c = 1, CH_3OH).

The oxalic acid salt of the (-)-isomer crystallized from acetone. MP: 147-148°C, $[\alpha]_D$ = -12.08° (c = 1, CH_3OH).

EXAMPLE 3

Preparation of citalopram by method c)

To an ice cooled solution of 28g of racemic diol base, II, in 500 ml of dichloromethane were added 32 ml of triethylamine, and 7.5 of methansulfonyl chloride in 30 ml of dichloromethane were added dropwise during ½ hour. The reaction mixture was washed with 0.1 M NaOH solution twice, the organic phase separated, dried ($MgSO_4$) and the solvent evaporated, leaving 21.5g of the title (±)-citalopram as a crystalline base. The thus-obtained material was dissolved in a mixture of 2-propanol and methanol (2:1) and an equivalent amount of gaseous HBr was introduced. The mixture was left overnight and the precipitated hydrobromide was filtered off. Yield: 26g with MP 184-186°C.

The enantiomers from Example 1 were tested for their ability to block 5-HT reuptake in standard and reliable test method. Results are shown in Table I in comparison with the racemic mixture of citalopram.

5-HTP-POTENTIATION

The test evaluates the ability of the substance to potentiate the effect of 5-HTP, which results in development of 5-HT syndrome (Christensen, Fjalland, Pedersen, Danneskiold-Samsøe and Svendsen; European J. Pharmacol. 41, 153-162, 1977).

Procedure

Each treatment group consists of 3 mice, and two groups are treated with the highest test dose. A control group only treated with 5-HTP is included and a group treated with citalopram 10 mg/kg and 5-HTP is used as reference for full 5-HT syndrome

The route of administration

30 minutes after the administration of the test substance, the other groups are given 5-HTP (100 mg/kg) i.v. (injection time 5-10 sec.). After this 5-HTP dose normal, untreated mice remain unaffected, but if the animals have been pretreated with a substance, which inhibits the uptake of 5-HT or a 5-HT agonist, a 5-HTP syndrome will occur. The symptoms are the same as previously described: 1) excitation, 2) tremor, and 3) abduction of the hind limbs. The animals are observed for 15 minutes and each animal is given one point for each symptom present. Again the result is stated in fractions: 0/9, 1/9, ..., 9/9, where 0, 1, ..., 9 are the number of points per group after the dose in question. The ED_{50} value is calculated by log-probit analysis.

INHIBITION OF ^{3}H-SEROTONIN UPTAKE IN RAT BRAIN SYNAPTOSOMES

By this method the inhibition by drugs of the uptake of ^{3}H-serotonin (^{3}H-5-HT) (10 nM) in rat brain synaptosomes is determined in vitro. Method and results in Hyttel, Psychopharmacology 1978, 60, 13-18; Hyttel, Prog.Neuro-Psychopharmacol. & Biol.Psychiat. 1982, 6, 277-295; Hyttel & Larsen, Acta pharmacol. tox. 1985, 56, suppl. 1, 146-153.

Procedure

Male Wistar (Mol:Wist) rats (125-250 g) are sacrificed by decapitation and exsanguinated. Brain tissue (minus cerebellum) is gently homogenized (glass teflon homogenizer) in 40 vol (w/v) of icecold 0.32 M of sucrose containing 1 mM of nialamide. The P_2 fraction (synaptosomal fraction) is obtained by centrifugation (600 g, 10 min and 25000 g, 55 min, 4 °C) and suspended in 800 volumes of a modified Krebs-Ringer-phosphate buffer, pH 7.4.

To 4000 µl of the synaptosomal suspension (5 mg original tissue) on ice are added 100 µl test substance in water. After preincubation at 37 °C for 5 min, 100 µl of ^{3}H-1-NA (final concentration 10 nM) are added and the samples are incubated for 10 min at 37 °C. The incubation is terminated by filtering the samples under vacuum through Whatman GF/F filters with a wash of 5 ml buffer containing 10 µM of unlabelled 5-HT. The filters are placed in counting vials and 4 ml of appropriate scintillation fluid (e.g. Picofluor ™ 15) are added. After shaking for 1 h and storage 2 h in the dark the content of radioactivity is determined by liquid scintillation counting. Uptake is obtained by subtracting the nonspecific binding and passive transport measured in the presence of 10 µM citalopram (Lu 10-171-B).

For determination of the inhibition of uptake five concentrations of drugs covering 3 decades are used.

The measured cpm are plotted against drug concentration on semilogarithmic paper, and the best fitting s-shaped curve is drawn. The IC_{50} -value is determined as the concentration, at which the uptake is 50% of the total uptake in control samples minus the nonspecific binding and uptake in the presence of 10 µM of citalopram.

Table 1

PHARMACOLOGICAL TEST RESULTS		
Compound	5-HTP pot. ED_{50} µmol/kg	5-HT uptake inhibition IC_{50} (nM)
(+)-citalopram	2.0	1.1
(-)-citalopram	120	150
(±)-citalopram	3.3	1.8

(+)-1-(3-Dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile ((+)-citalopram) and the non-toxic acid addition salts thereof may be administered to animals, such as dogs, cats, horses and sheep, (including humans beings), both orally and parenterally, and may be used, for example, in the form of tablets, capsules, powders, syrups or in the form of the usual sterile solutions for injection.

Most conveniently the compounds of Formula I are administered orally in unit dosage form such as tablets or capsules, each dosage unit containing the free amine or a non-toxic acid addition salt of one of the said compounds in a amount of from abut 0.10 to about 100 mg, most preferably, however, from about 5 to 50 mg, calculated as the free amine, the total daily dosage usually ranging from about 1.0 to about 500 mg. The exact individual dosages as well as daily dosages in a particular case will, of course, be determined according to established medical principles under the direction of a physician.

When preparing tablets, the active ingredient is for the most part mixed with ordinary tablet adjuvants, such as corn starch, potato starch, talcum, magnesium stearate, gelatine, lactose and gums.

Typical examples of formulations containing (+)-citalopram in the form of an acid addition salt as the active ingredient, are as follows:

1) Tablets containing 5 milligrams of (+)-citalopram calculated as the free base:

Compound 20	5 mg
Lactose	18 mg
Potato starch	27 mg
Saccharose	58 mg
Sorbitol	3 mg
Talcum	5 mg
Gelatine	2 mg
Povidone	1 mg
Magnesium stearate	0.5 mg

2) Tablets containing 50 milligrams of (+)-citalopram calculated as the free base:

(+)-citalopram	50 mg
Lactose	16 mg
Potato starch	45 mg
Saccharose	106 mg
Sorbitol	6 mg
Talcum	9 mg
Gelatine	4 mg
Povidone	3 mg
Magnesium stearate	0.6 mg

3) Syrup containing per milliliter:

(+)-citalopram	10 mg
Sorbitol	500 mg
Tragacanth	7 mg
Glycerol	50 mg
Methyl-paraben	1 mg
Propyl-paraben	0.1 mg
Ethanol	0.005 ml
Water	ad 1 ml

4) Solution for injection containing per milliliter:

(+)-citalopram	50 mg
Acetic acid	17.9 mg
Sterile water	ad 1 ml

5) Solution for injection containing per milliliter:

(+)-citalopram	10 mg
Sorbitol	42.9 mg
Acetic acid	0.63 mg
Sodium hydroxide	22 mg
Sterile water	ad 1 ml

Any other pharmaceutical tableting adjuvants may be used provided that they are compatible with the active ingredient, and additional compositions and dosage forms may be similar to those present used for neuroleptics, analgesics or antidepressants.

Also combinations of (+)-citalopram as well as its non-toxic acid salts with other active ingredients, especially other neuroleptics, thymoleptics, tranquilizers or analgesics fall within the scope of the present invention.

As previously stated, when isolating the enantiomers of citalopram in the form of an acid addition salt the acid is preferably selected so as to contain an anion which is non-toxic and pharmacologically acceptable, at least in usual therapeutic doses. Representative salts which are included in this preferred group are the hydrochlorides, hydrobromides, sulphates, acetates, phosphates, nitrates, methanesulphonates, ethane-sulphonates, lactates, citrates, tartrates or bitartrates, pamoates and maleates of the amines of Formula I. Other acids are likewise suitable and may be employed if desired. For example: fumaric, benzoic, ascorbic, succinic, salicylic, bismethylenesalicylic, propionic, gluconic, malic, malonic, mandelic, cinnamic, citraconic, stearic, palmitic, itaconic, glycolic, benzenesulphonic, and sulphamic acids may also be employed as acid addition salt-forming acids.

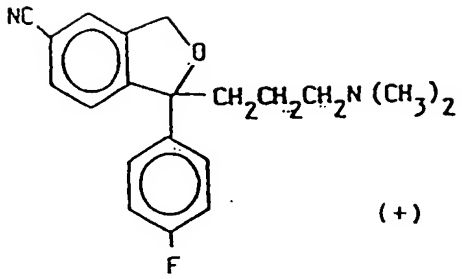
When it is desired to isolate a compound of the invention in the form of the free base, this may be done according to conventional procedure as by dissolving the isolated or unisolated salt in water, treating with a suitable alkaline material, extracting the liberated free base with a suitable organic solvent drying the extract and evaporating to dryness or fractionally distilling to effect isolation of the free basic amine.

The invention also comprises a method for the alleviation, palliation, mitigation or inhibition of the manifestations of certain physiological-psychological abnormalities of animals, especially depressions by administering to a living animal body, including human beings, an adequate quantity of (+)-citalopram or a non-toxic acid addition salt thereof. An adequate quantity would be from about 0.001 mg to about 10 mg per kg of body weight in each unit dosage, and from about 0.003 milligrams to about 7 milligrams/kg of body weight per day.

Claims

Claims for the following Contracting States : AT, BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

1. (+)-1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile having the general formula



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and non-toxic acid addition salts thereof.

2. The pamoic acid addition salt of the compound of claim 1.

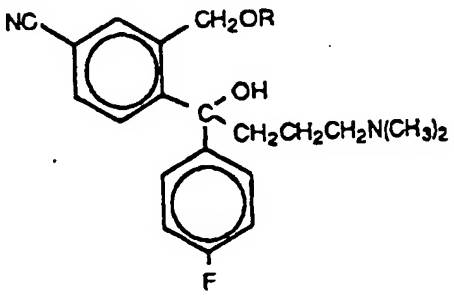
3. A pharmaceutical composition in unit dosage form comprising as an active ingredient, a compound as defined in claim 1.

4. A pharmaceutical composition in unit dosage form comprising, as an active ingredient, the compound of claim 2.

5. A pharmaceutical composition in unit dosage form, according to claim 3 or 4, wherein the active ingredient is present in an amount from 0.1 to 100 milligram per unit dose.

6. A method for the preparation of a compound as defined in claim 1, which comprises, converting (-)-4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl) benzonitrile or a monoester thereof in a stereoselective way to (+)-1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile which is isolated as such or as a non-toxic acid addition salt thereof.

7. (-)-Enantiomer of the compound 4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)-benzonitrile or an ester of said (-) enantiomer, which ester has the general formula

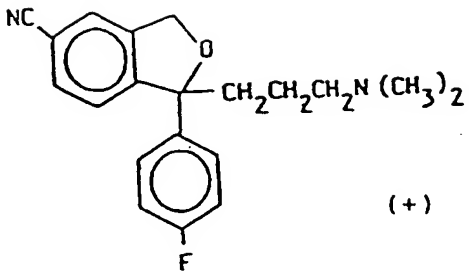


II

wherein R is a labile ester group.

Claims for the following Contracting State : ES

1. A method for the preparation of (+)-1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile having the general formula



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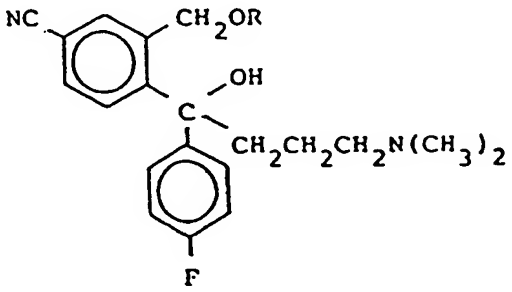
(+)

and non-toxic acid addition salts thereof which comprises converting (-)-4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile or a monoester thereof having the formula



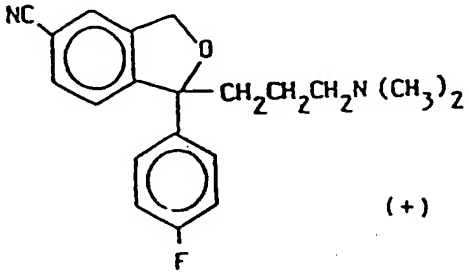
II

wherein R is H or a labile ester group in a stereoselective way and then isolating the compound of Formula I as such or as a non-toxic acid addition salt thereof.

2. A method according to claim 1, wherein the compound of Formula I is isolated as the pamoic acid addition salt.

Claims for the following Contracting State : GR

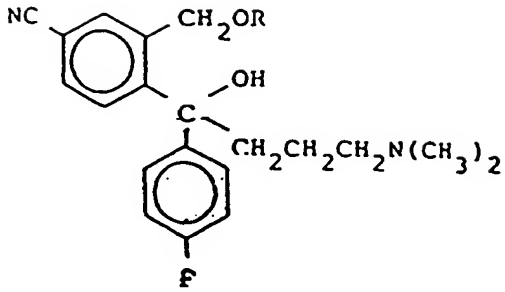
1. A method for the preparation of (+)-1-(3-dimethylaminopropyl)-1-(4'-fluorophenyl)-1,3-dihydroisobenzofuran-5-carbonitrile having the general formula



I

(+)

and non-toxic acid addition salts thereof which comprises converting (-)-4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile or a monoester thereof having the formula

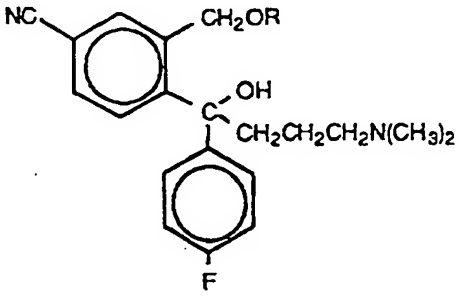


II

wherein R is H or a labile ester group in a stereoselective way and then isolating the compound of Formula I as such or as a non-toxic acid addition salt thereof.

2. A method according to claim 1, wherein the compound of Formula I is isolated as the pamoic acid addition salt.

3. (-)-Enantiomer of the compound 4-[4-(dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitrile or an ester of said (-)enantiomer, which ester has the general formula

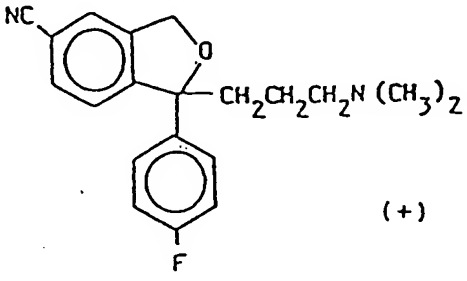


II

wherein R is a labile ester group.

Patentansprüche
Patentansprüche für folgende Vertragsstaaten : AT, BE, CH, DE, FR, GB, LT, LI, LU, NL, SE

1. (+)-1-(3-Dimethylaminopropyl)-1-(4'-fluorphenyl)-1,3-dihydroisobenzofuran-5-carbonitril mit der allgemeinen Formel



I

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und dessen nicht-toxische Säure-Additionssalze.

2. Das Säure-Additionssalz der Verbindung nach Anspruch 1 mit der Pamoasäure.

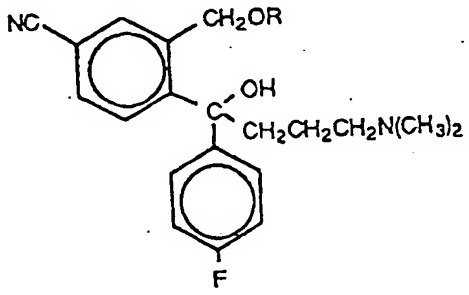
3. Pharmazeutische Zusammensetzung in Einheitsdosierungsform, umfassend als aktiven Bestandteil eine Verbindung wie in Anspruch 1 definiert.

4. Pharmazeutische Zusammensetzung in Einheitsdosierungsform, umfassend als aktiven Bestandteil die Verbindung wie in Anspruch 2 definiert.

5. Die pharmazeutische Zusammensetzung in Einheitsdosierungsform nach Anspruch 3 oder 4, wobei der aktive Bestandteil in einer Menge von 0,1 - 100 mg pro Einheitsdosis vorliegt.

6. Verfahren zur Herstellung einer Verbindung, wie sie in Anspruch 1 definiert ist, wobei das Verfahren den Schrittumfaßt, (-)-4-[4-(Dimethylamino)-1-(4'-fluorphenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)-benzonitril oder einen seiner Monoester auf stereoselektive Weise in (+)-1-(3-Dimethylaminopropyl)-1-(4'-fluorphenyl)-1,3-dihydroisobenzofuran-5-carbonitril umzuwandeln, das entweder als solches oder als sein nicht-toxisches Säure-Additionssalz isoliert wird.

7. (-)-Enantiomer der Verbindung 4-[4-(Dimethylamino)-1-(4'-fluorphenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitril oder ein Ester dieses (-)-Enantiomeren, wobei der Ester die allgemeine Formel

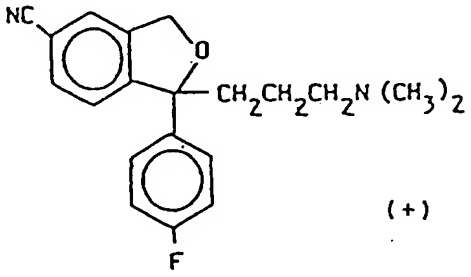


II

hat, in der R eine labile Ester-Gruppe ist.

Patentansprüche für folgenden Vertragsstaat : ES

1. Verfahren zur Herstellung von (+)-1-(3-Dimethylaminopropyl)-1-(4'-fluorphenyl)-1,3-dihydroisobenzofuran-5-carbonitril mit der allgemeinen Formel



I

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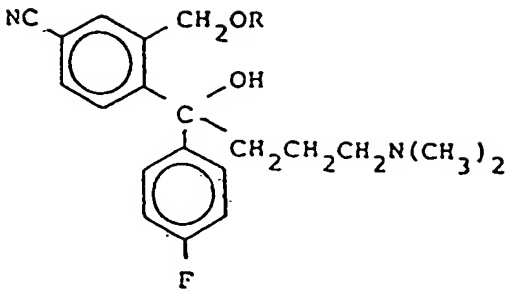
und seinen nicht-toxischen Säure-Additionssalzen, das den Schritt umfaßt, (-)-4-[4-(Dimethylamino)-1-(4'-fluorphenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitril oder einen seiner Monoester mit der Formel



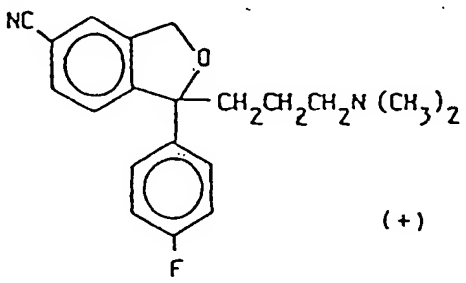
II

in der R Wasserstoff oder eine labile Ester-Gruppe ist, in einer stereoselektiven Weise umzuwandeln und dann die Verbindung der Formel I als solche oder als ihr nicht-toxisches Säure-Additionssalz zu isolieren.

2. Das Verfahren nach Anspruch 1, wobei die Verbindung der Formel I als das Säure-Additionssalz mit der Pamoasäure isoliert wird.

Patentansprüche für folgenden Vertragsstaat : GR

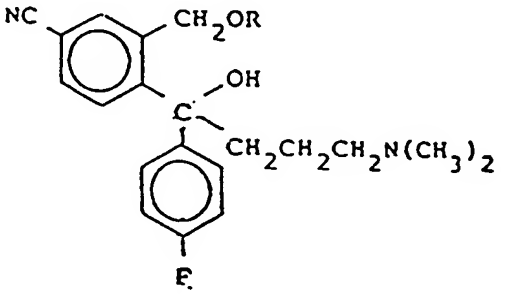
1. Verfahren zur Herstellung von (+)-1-(3-Dimethylaminopropyl)-1-(4'-fluorphenyl)-1,3-dihydroisobenzofuran-5-carbonitril mit der allgemeinen Formel



I

(+)

und seinen nicht-toxischen Säure-Additionssalzen, das den Schritt umfaßt, (-)-4-[4-(Dimethylamino)-1-(4'-fluorphenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitril oder einen seiner Monoester mit der Formel

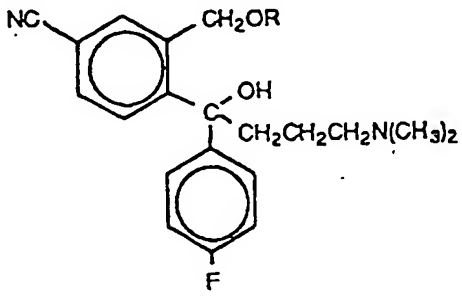


II

in der R Wasserstoff oder eine labile Ester-Gruppe ist, in einer stereoselektiven Weise umzuwandeln und dann die Verbindung der Formel I als solche oder als ihr nicht-toxisches Säure-Additionssalz zu isolieren.

2. Das Verfahren nach Anspruch 1, wobei die Verbindung der Formel I als das Säure-Additionssalz mit der Pamoasäure isoliert wird.

3. (-)-Enantiomer der Verbindung 4-[4-(Dimethylamino)-1-(4'-fluorophenyl)-1-hydroxy-1-butyl]-3-(hydroxymethyl)benzonitril oder ein Ester dieses (-)-Enantiomeren, wobei der Ester die allgemeine Formel



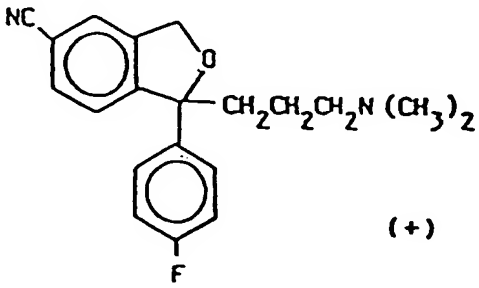
II

hat, in der R eine labile Ester-Gruppe ist.

Revendications

Revendications pour les Etats contractants suivants : AT, BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

1. (+)-1-(3-diméthylaminopropyl)-1-(4'-fluorophényl)-1,3-dihydro-isobenzofuranne-5-carbonitrile répondant à la formule générale



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et ses sels d'addition d'acides non toxiques.

2. Sel d'addition de l'acide pamoïque du composé de la revendication 1.

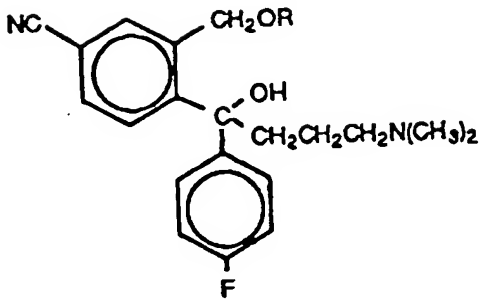
3. Composition pharmaceutique sous forme d'une dose unitaire comprenant, comme ingrédient actif, un composé tel que défini dans la revendication 1.

4. Composition pharmaceutique sous forme d'une dose unitaire comprenant, comme ingrédient actif, le composé de la revendication 2.

5. Composition pharmaceutique sous forme d'une dose unitaire selon la revendication 3 ou 4, dans laquelle l'ingrédient actif est présent en une quantité de 0,1 à 100 milligrammes par dose unitaire.

6. Procédé pour la préparation d'un composé tel que défini dans la revendication 1, qui comprend la conversion du (-)-4-[4-(diméthylamino)-1-(4'-fluorophényl)-1-hydroxy-1-butyl]-3-(hydroxyméthyl)-benzonitrile, ou d'un monoester de celui-ci, de façon stéréosélective en le (+)-1-(3-diméthylaminopropyl)-1-(4'-fluorophényl)-1,3-dihydro-isobenzofuranne-5-carbonitrile que l'on isole tel quel ou sous forme d'un de ses sels d'addition d'acides non toxiques.

7. Enantiomère (-) du composé 4-[4-(diméthylamino)-1-(4'-fluorophényl)-1-hydroxy-1-butyl]-3-(hydroxyméthyl)benzonitrile ou d'un ester dudit énantiomère (-), lequel ester répond à la formule générale

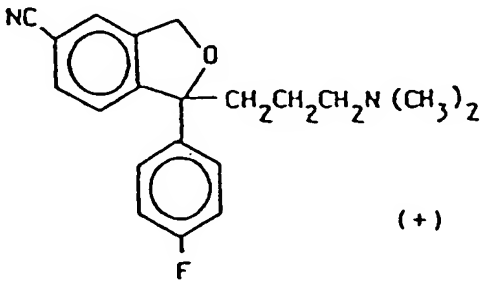


II

dans laquelle R est un groupe ester labile.

Revendications pour l'Etat contractant suivant : ES

1. Procédé pour la préparation du (+)-1-(3-diméthylaminopropyl)-1-(4'-fluorophényl)-1,3-dihydro-isobenzofuranne-5-carbonitrile répondant à la formule générale



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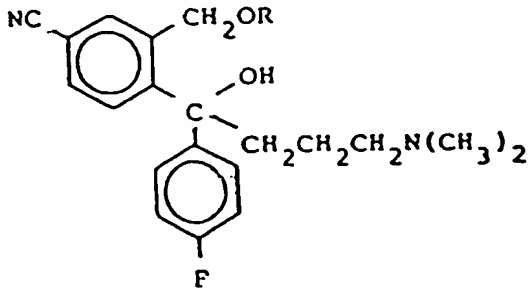
et ses sels d'addition d'acides non toxiques, qui comprend la conversion du (-)-4-[4-(diméthylamino)-1-(4'-fluorophényl)-1-hydroxyl-1-butyl]-3-(hydroxyméthyl)benzonitrile, ou d'un monoester de celui-ci, répondant à la formule



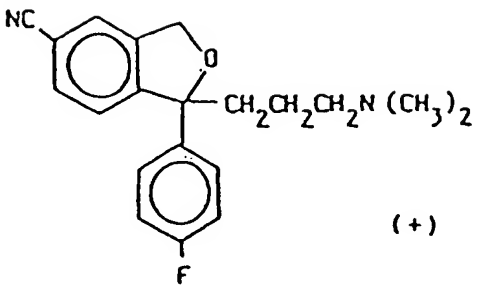
II

dans laquelle R est H ou un groupe ester labile, de façon stéréosélective, puis l'isolement du composé de formule I tel quel ou sous forme d'un de ses sels d'addition d'acides non toxiques.

2. Procédé selon la revendication 1 dans lequel le composé de formule I est isolé sous forme du sel d'addition de l'acide pamoïque.

Revendications pour l'Etat contractant suivant : GR

1. Procédé pour la préparation du (+)-1-(3-diméthylaminopropyl)-1-(4'-fluorophényl)-1,3-dihydro-isobenzofuranne-5-carbonitrile répondant à la formule générale



I

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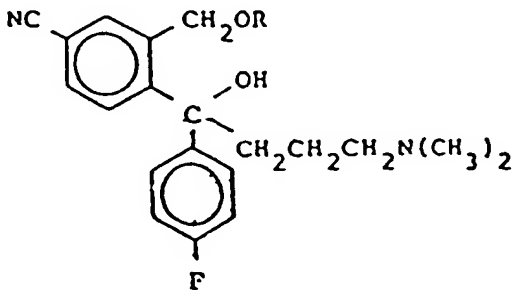
et ces sels d'addition d'acides non toxiques, qui comprend la conversion du (-)-4-[4-(diméthylamino)-1-(4'-fluorophényl)-1-hydroxy-1-butyl]-3-(hydroxyméthyl)benzonitrile, ou d'un monoester de celui-ci, répondant à la formule

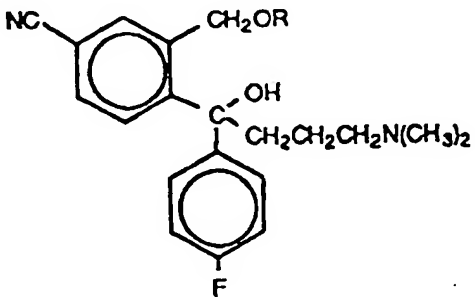


II

dans laquelle R est H ou un groupe ester labile, de façon stéréosélective, puis l'isolement du composé de formule I tel quel ou sous forme d'un de ses sels d'addition d'acides non toxiques.

2. Procédé selon la revendication 1 dans lequel le composé de formule I est isolé sous forme du sel d'addition de l'acide pamoïque.

3. Enantiomère (-) du composé 4-[4-(diméthylamino)-1-(4'-fluorophényl)-1-hydroxy-1-butyl]-3-(hydroxyméthyl)benzonitrile ou d'un ester dudit énantiomère (-), lequel ester répond à la formule générale



II

dans laquelle R est un groupe ester labile.